Latin Hypercube Sampling with Dependence and Applications in Finance

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Abstract

In Monte Carlo simulation, Latin hypercube sampling (LHS) [McKay et al. (1979)] is a well-known variance reduction technique for vectors of independent random variables. The method presented here, Latin hypercube sampling with dependence (LHSD), extends LHS to vectors of dependent random variables. The resulting estimator is shown to be consistent and asymptotically unbiased. For the bivariate case and under some conditions on the joint distribution, a central limit theorem together with a closed formula for the limit variance are derived. It is shown that for a class of estimators satisfying some monotonicity condition the LHSD limit variance is never greater than the corresponding Monte Carlo limit variance. In some valuation examples of financial payoffs, when compared to standard Monte Carlo simulation, a variance reduction of factors up to 200 is achieved. LHSD is suited for problems with rare events and for high-dimensional problems, and it may be combined with Quasi-Monte Carlo methods.

Keywords: Monte Carlo simulation, variance reduction, Latin hypercube sampling, stratified sampling

JEL Classification: C15, C63, G12

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